FLUX RATIO FOR STOPPING PARTICLES

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1.0 Software FRSP to calculate Flux Ratio for Stopping Particles

Software package FRSP uses ten programs to perform nine stages of experimental data analysis. The final results of data analysis are fluxes and flux ratios of galactic component of flux for nuclei with charges in a range from Z=3 to Z=30. In the following sections short description of all stages of data analysis are given.

1.1 Selection of Experimental Events

Programs: COPY_FILE, CUT_SIGNAL

On this level of data analysis (program COPY_FILE) all stopping events with "caution bit" zero and not negligible signal in the C-layer of a detector are selected. Additional selection is performed to remove Helium and Hydrogen elements. For selected events, the energy deposited in the detector layers and a "tag" word in decimal representation are written to the output file. The next program CUT_SIGNAL removes noise events with a very low energy deposited in A1 (or B1) detector layer compared to energy deposited in A2 and C123 (or B2 and C432) detector layers.

The output from the program COPY_FILE is the file with selected events and is plotted in Fig.1 (figure is plotted with the program M.' TDRAW).

The output from the program CUT_SIGNAL is the file with further selection of events and is plotted in Fig.2 (figure is plotted by the program MATDRAW).

1.2 Fit of Simulation Tracks to Experimental Events

Program: MATDRAW

The program MATDRAW produces plots of experimental events and simulation tracks in a selected 2-dimensional energy space. The energy space is determined by the selected combination of detector layers. The program can be used to plot experimental events and simulation tracks with marked energy bins or to perform a fit of simulation tracks to experimental events.

There are five possible plots of experimental events and simulation tracks listed below

1 - A1 versus A2 (or B1 versus B2)
2 - A1 versus C123 (or B1 versus C432)
3 - A1 versus (A2+C123) (or B1 vs (B2+C432))
4 - A2 versus C123 (or B2 vs C432)
5 - (A1+A2) versus C123 (or (B1+B2) vs C432)

where A1, A2, C123 (or B1, B2, and C432) are energies deposited by an event in the detector layers marked with the same labels.

There are two possible types of data files with experimental events on which this program can work. The first type of the data file is produced by the CUT_SIGNAL program. This file has only information about energies deposited in detector layers and a TAG word.

The second type of a file with experimental events is produced by the program TREVTNEW. The events on this file have already determined charge. For these events with determined charge program has an option which allows to plot only these experimental events which are within a selected interval of a charge spread or which are within a given charge limits.

The program MATDRAW uses three input data files. The first file (DATAFILE) has experimental events and can be produced by the program CUT_SIGNAL or by the program TREVTNEW.

The second file (NASIM) with simulation tracks is generated by the program DETMOD.

The third file (NBINFILE) with energy bins is generated by the program EBINNEW.

Figs. 3 and 4 illustrate quality of a fit of simulation tracks to experimental events performed in three dimensional space A1, A2, and C123. Fig. 3 illustrates quality of the fit in A1 versus C123 energy space and Fig. 4 in A2 versus C123. We used experimental data for A-stopping mode (Voyager-1, 1986-87 year).

1.3 Calculation of Charge, Energy per Nucleon and Geometric Factor

Program: TREVTNEW

The program TREVTNEW determines three quantities ("fractional" charge ZEVT, energy per nucleon EK , and geometric factor GEOFAC) essential for charge analysis in the next stage of data analysis and two other quantities (the energy ENEW and geometric factor GNEW) used to determine spallation corrections.

The first three quantities are found by considering several simulation tracks generated for different charges in two different two-dimensional spaces for energies deposited in detector layers.

The first components of "fractional" charge ZEVT(1), energy per nucleon EK(1), and geometric factor GEOFAC(1) result from analysis of energies deposited in A1 and C123 (if A-mode is requested) or in B1 and C432 (if B-mode is requested).

The second components of "fractional" charge ZEVT(2), energy per nucleon EK(2), and geometric factor GEOFAC(2) result from analysis of energies deposited in A2 and C123 (if A-mode is requested) or in B2 and C432 (if B-mode is requested).

The method used in this program finds a minimum distance between a point corresponding to the experimental event and points from closest neighboring simulation tracks.

Two other quantities, the energy ENEW, and geometric factor GNEW are calculated using the energy deposited in the C detector layer and adding corrections due to energy deposited in the first two detector layers (A1 and A2 if A-stopping is selected or B1 and B2 if B-stopping is selected). The energy and range calculated with this method are used to calculate spallation corrections.

The geometry factor GNEW, energy EK and range XK are interpolated from two simulation values corresponding to the two simulation events which are in a shortest distance from the considered experimental event. For the energy EK additional corrections are included due to energy deposited in the first two detector layers.

The program TREVTNEW takes into account all simulation events which produce signals in the C-detector (energy deposited has to be larger than 0.001 MeV). The simulation tracks are smoothed out by rejecting some of the events which produce a "kink" type irregularities.

The experimental events are read from the file which is produced by the program COPY_FILE or CUT_SIGNAL. Both programs perform selection of experimental events.

The program TREVTNEW has to be used twice. The first time the program is run to determine charge, energy and geometric factor. The second time the program is run to calculate the geometry factor GNEW, energy EK, range XK, and two spallation corrections. To calculate these five quantities it is necessary to use well determined charge limits for all elements and parameters determining charge spread. Because of this the program TREVTNEW is run second time when the analysis of charge resolution is performed.

1.4 Analysis of Charge Resolution

Program: PLRESZ

The program PLRESZ can be used to plot

* charge histograms
* spread (Z2-Z1) versus average charge (Z1 + Z2)/2
* charge Z2 versus Z1

There are three types of histograms which can be plotted.

* histogram of charge Z1.
  The charge Z1 determined in the analysis of events
  in A1-C123 in the case of A-stopping mode (or B1-C432 for
  B-stopping mode)

* histogram of charge Z2.
  The charge Z2 determined in the analysis of events
  in A2-C123 in the case of A-stopping mode (or B2-C432 for
  B-stopping mode)

* histogram of average charge determined in the analysis
  in A1-C123 and A2-C123 in the case of A-stopping mode
  (or B1-C432 and B2-C432 for B-stopping mode).

The program PLRESZ uses the file DATAFILE produced by the program TREVTNEW.

Charge histograms of average charge are plotted to determine charge intervals (see Fig.5) for all elements. The average charge is determined from analysis of experimental events in two energy spaces, one determined by energies deposited in A1 and C123 (or B1 and C432) detector layers and another one by energies deposited in A2 and C123 (or B2 and C432).

The second quantity which is calculated is the charge spread (Z2-Z1) versus the average charge (Fig. 6). The charges Z1 and Z2 correspond to charges calculated in A1 versus C123 or A2 versus

C123 energy spaces (or B1 versus C432 and B2 versus C432). In this part of charge analysis the charge spread is calculated and used on further stages of data analysis.

An example of histogram for average charge is presented in Fig. 5. In Figs. 6 and 7 charge spread (Z2-Z1) is presented versus average charge for A-stopping events (Voyager-1, 1986-87 year). Two solid lines mark three standard deviations (3 sigma) in charge spread. All events outside the region determined by two solid lines are discarded in further analysis.

1.5 Calculation of Energy Range and Limits of Energy Bins.

Program: EBINNEW

Program EBINNEW calculates energy range interval for every considered element. The energy range interval is given by two quantities EKMIN and EKMAX. Additionally to energy range, the program calculates the energies ELIM determining boundaries of energy bins. There are seven energy bins which are determined by EKMIN, EKMAX, and six ELIM values.

The program EBINNEW uses data file with simulation tracks produced by the program DETMOD. The output results from the program EBINNEW are used by the program SPECTRE to calculate fluxes for several energy bins.

An example of the output from the program EBINNEW is in the Table 1.

1.6 Calculation of Fluxes

Program: SPECTRE

The program SPECTRE calculates total flux for every charge starting with Z=3 up to Z=30.
The second quantity is partial flux calculated for every charge and seven energy bins for a selected stopping mode.
In the calculations of fluxes the effects of geometric factors and spallations corrections are also included.

The output from the program includes fluxes, values of energy ranges and energy bins for all elements. The total flux corresponding to energy range and partial fluxes corresponding to seven energy bins are given in Table 2. The results correspond to A-stopping particles (Voyager-1, time period 1986-87).

To use the program SPECTRE it is necessary to perform earlier stages of data analysis with programs TREVTNEW, PLRESZ, and EBINNEW. Please note, that before calculating fluxes the program TREVTNEW has to be run the second time. The second run is with input data which includes results from the analysis of charge resolution.

1.7 Calculation of Slopes for Fluxes

Program: FITGAL2

The program FITGAL2 performs fit of a galactic part of flux versus energy with a two parameter function. To perform fit it is necessary to use flux values determined from the analysis of A-stopping and B-stopping events. The used here experimental values of flux correspond to all energy bins for both, A- and B-stopping, modes.

The parameters of the fitted function are needed in the next stage of data analysis to calculate flux ratios for selected pairs of elements.

Program allows to select a subset of experimental flux values for fit. Only values which are within energy interval which is of interest should be selected. Some of the experimental values of flux which do not follow general trend of other values from the considered set can be excluded from the fit procedure.

The output from the program is the plot of experimental flux values and of the fitted two parameter function. The fit parameters are printed in the plot.

To use the program FITGAL2 it is necessary to determine flux values for different energy bins with the program SPECTRE.

Fig. 8 presents flux versus energy for C (Z=6) element in the log-log scale. The slope is determined only for the experimental points (marked with triangles) within the energy interval which is common to both elements selected to calculate flux ratio.

1.8 Calculation of Flux Ratios

Program: CORRATIO2

The program CORRATIO2 calculates flux ratios of a galactic component of flux for selected pairs of elements with charge Z ranging from Z=3 to Z=30.

The most important quantities in the output from the program CORRATIO2 are the flux ratio, statistical and systematic errors and the average energy of measurement.

To use the program CORRATIO2 it is necessary to perform earlier stages of data analysis with programs SPECTRE and FITGAL2.

The output is directed to the file RESFILE and to the terminal.

In the example of the output from the program CORRATIO2 (see Table 3.) the following pairs of elements are selected Be/C, B/C, Na/Mg, Al/Si.

1.9 Plotting of Fluxes versus Energy

Program: PLSPECT

The program PLSPECT generates plots of fluxes in log(flux)-log(energy) space. The experimental values of flux are plotted for several values of energy corresponding to different energy bins.

The program PLSPECT uses data file with fluxes generated by the program SPECTRE.

An example of the plot of flux versus energy for elements C and O, is shown in Fig. 9

Table 1.

The values of energy ranges and energy bins produced for A-stopping events by the program EBINNEW.

```
Energy bins for elements
simulation file: repv1d11.sim     Gain & Mode:LG AS
Ranges for bin definition:     673.     1237.     2507.     4179.     7018.     9870.
```

								Z	A
			Energy bins						
6.96	9.92	14.02	20.86	27.79	37.15	44.95	57.21	1	1.00
6.36	10.00	14.15	21.06	28.06	37.50	45.39	57.78	2	3.93
7.48	11.86	16.77	24.97	33.26	44.46	53.83	68.55	3	6.52
9.16	14.65	20.69	30.80	41.03	54.87	66.45	85.10	4	7.96
9.90	15.89	22.48	33.49	44.63	59.70	72.34	92.68	5	10.69
11.30	18.19	25.75	38.37	51.14	68.46	82.99	106.43	6	12.06
12.05	19.45	27.56	41.11	54.82	73.42	89.03	114.25	7	14.49
13.17	21.28	30.18	45.04	60.08	80.52	97.69	125.47	8	16.06
13.55	22.01	31.27	46.71	62.35	83.61	101.47	130.38	9	19.00
14.45	23.51	33.42	49.98	66.75	89.55	108.75	139.83	10	20.76
15.09	24.63	35.06	52.46	70.10	94.10	114.32	147.09	11	23.00
15.89	26.03	37.13	55.66	74.42	99.99	121.54	156.52	12	24.57
16.41	26.98	38.52	57.79	77.32	103.94	126.40	162.88	13	26.91
17.28	28.45	40.66	61.05	81.75	109.95	133.78	172.52	14	28.26
17.66	29.13	41.66	62.60	83.84	112.81	137.29	177.13	15	31.00
18.37	30.35	43.45	65.33	87.56	117.90	143.56	185.33	16	32.63
18.57	30.79	44.17	66.50	89.17	120.11	146.30	188.96	17	35.62
19.24	31.99	45.90	69.14	92.76	125.05	152.38	196.95	18	37.20
19.62	32.66	46.89	70.68	94.86	127.92	155.93	201.62	19	39.82
20.08	33.50	48.16	72.66	97.59	131.68	160.57	207.75	20	41.92
20.32	33.87	48.76	73.67	98.99	133.63	162.92	210.98	21	45.00
20.74	34.65	49.95	75.53	101.56	137.18	167.32	216.79	22	47.15
20.99	35.21	50.85	77.03	103.66	140.11	170.97	221.64	23	49.61
21.44	36.03	52.09	79.00	106.37	143.85	175.61	227.80	24	51.56
21.75	36.65	53.08	80.54	108.52	146.84	179.31	232.73	25	53.94
22.19	37.49	54.31	82.50	111.20	150.56	183.94	238.88	26	55.82
22.49	38.10	55.29	84.09	113.44	153.69	187.75	244.10	27	58.02
23.19	39.33	57.10	86.91	117.32	159.05	194.41	252.93	28	58.78
22.85	38.92	56.63	86.34	116.63	158.20	193.39	251.65	29	63.54
23.26	39.69	57.82	88.21	119.22	161.81	197.89	257.64	30	65.35

Table 2.

Flux values for different elements and several energy bins for A-stopping events(Voyager-1, 1986-87). Table is generated with the program SPECTRE.

```
AS  Analysis for: s3av18687as.dat                        Spall.corr.: 2
Evts selected with |Z2-Z1| <= 3.00*sigma
with sigma = 0.0550 + 0.0055*zav
Evts read, selected:        4079       3198
Charge limits:
   0.5    1.5    2.5    3.5    4.5    5.4    6.4    7.4    8.4    9.4
  10.5   11.3   12.5   13.5   14.5   15.5   16.5   17.5   18.5   19.4
  20.5   21.4   22.5   23.4   24.6   25.5   26.5   27.4   28.5   29.5   30.5
```

Charge	# of evts	# /cm2.sr	Energy range (MeV/n)	
1	0.	0.00	6.96	57.21
2	0.	0.00	6.36	57.78
3	138.	119.81	7.48	68.55
4	37.	30.46	9.16	85.10
5	80.	77.88	9.90	92.68
6	440.	423.62	11.30	106.43
7	285.	243.96	12.05	114.25
8	1531.	1308.92	13.17	125.47
9	14.	13.64	13.55	130.38
10	125.	115.71	14.45	139.83
11	17.	16.19	15.09	147.09
12	139.	133.60	15.89	156.52
13	33.	33.14	16.41	162.88
14	117.	111.77	17.28	172.52
15	3.	3.03	17.66	177.13
16	15.	14.37	18.37	185.33
17	3.	3.15	18.57	188.96
18	8.	7.21	19.24	196.95
19	2.	1.94	19.62	201.62
20	18.	17.40	20.08	207.75
21	5.	4.95	20.32	210.98
22	20.	18.79	20.74	216.79
23	9.	8.57	20.99	221.64
24	18.	17.29	21.44	227.80
25	20.	19.22	21.75	232.73
26	113.	105.37	22.19	238.88
27	3.	2.94	22.49	244.10
28	5.	4.89	23.19	252.93
29	0.	0.00	22.85	251.65
30	0.	0.00	23.26	257.64

Charge= 2

Energy bin		Evts	#/cm2.sr	#/cm2.sr.MeV/n
6.36	10.00	0.	0.0000	0.0000
10.00	14.15	0.	0.0000	0.0000
14.15	21.06	0.	0.0000	0.0000
21.06	28.06	0.	0.0000	0.0000
28.06	37.50	0.	0.0000	0.0000
37.50	45.39	0.	0.0000	0.0000
45.39	57.78	0.	0.0000	0.0000
Sum =		0.	0.0000	

Charge= 3

Energy bin		Evts	#/cm2.sr	#/cm2.sr.MeV/n
7.48	11.86	32.	24.9607	5.6988
11.86	16.77	10.	7.8034	1.5893
16.77	24.97	13.	10.1670	1.2399
24.97	33.26	22.	18.1965	2.1950

33.26	44.46	31.	27.4895	2.4544
44.46	53.83	13.	12.6305	1.3480
53.83	68.55	17.	18.5646	1.2612
Sum =		138.	119.8122	

Charge= 4

Energy bin		Evts	#/cm2.sr	#/cm2.sr.MeV/n
9.16	14.65	2.	1.5610	0.2843
14.65	20.69	9.	7.0254	1.1631
20.69	30.80	13.	10.1673	1.0057
30.80	41.03	7.	5.7946	0.5664
41.03	54.87	2.	1.7483	0.1263
54.87	66.45	2.	1.9828	0.1712
66.45	85.10	2.	2.1805	0.1169
Sum =		37.	30.4601	

Charge= 5

Energy bin		Evts	#/cm2.sr	#/cm2.sr.MeV/n
9.90	15.89	0.	0.0000	0.0000
15.89	22.48	7.	5.4653	0.8293
22.48	33.49	6.	4.6949	0.4264
33.49	44.63	8.	6.6561	0.5975
44.63	59.70	15.	13.3808	0.8879
59.70	72.34	11.	10.6357	0.8414
72.34	92.68	33.	37.0491	1.8215
Sum =		80.	77.8818	

Charge= 6

Energy bin		Evts	#/cm2.sr	#/cm2.sr.MeV/n
11.30	18.19	11.	8.5888	1.2466
18.19	25.75	18.	14.0550	1.8591
25.75	38.37	31.	24.2329	1.9202
38.37	51.14	58.	47.3288	3.7062
51.14	68.46	84.	74.4313	4.2974
68.46	82.99	93.	91.1895	6.2759
82.99	106.43	145.	163.7961	6.9879
Sum =		440.	423.6223	

Charge= 7

Energy bin		Evts	#/cm2.sr	#/cm2.sr.MeV/n
12.05	19.45	93.	72.6264	9.8144
19.45	27.56	51.	39.8291	4.9111
27.56	41.11	34.	26.5584	1.9600
41.11	54.82	19.	15.3974	1.1231
54.82	73.42	30.	26.6234	1.4314
73.42	89.03	19.	18.7009	1.1980
89.03	114.25	39.	44.2227	1.7535
Sum =		285.	243.9584	

Charge= 8

Energy bin		Evts	#/cm2.sr	#/cm2.sr.MeV/n
13.17	21.28	619.	483.4609	59.6129
21.28	30.18	202.	157.7647	17.7264
30.18	45.04	179.	139.9179	9.4157
45.04	60.08	88.	72.0082	4.7878

60.08	80.52	116.	103.3752	5.0575
80.52	97.69	118.	116.0119	6.7567
97.69	125.47	209.	236.3727	8.5087
Sum =		1531.	1308.9115	

Charge= 9

Energy bin		Evts	#/cm2.sr	#/cm2.sr.MeV/n
13.55	22.01	1.	0.7811	0.0923
22.01	31.27	0.	0.0000	0.0000
31.27	46.71	0.	0.0000	0.0000
46.71	62.35	4.	3.1962	0.2044
62.35	83.61	2.	1.7580	0.0827
83.61	101.47	1.	0.9649	0.0540
101.47	130.38	6.	6.9367	0.2399
Sum =		14.	13.6370	

Charge= 10

Energy bin		Evts	#/cm2.sr	#/cm2.sr.MeV/n
14.45	23.51	17.	13.2812	1.4659
23.51	33.42	17.	13.2799	1.3400
33.42	49.98	12.	9.3908	0.5671
49.98	66.75	12.	9.7391	0.5807
66.75	89.55	11.	9.8534	0.4322
89.55	108.75	19.	18.4520	0.9610
108.75	139.83	37.	41.7187	1.3423
Sum =		125.	115.7151	

Charge= 11

Energy bin		Evts	#/cm2.sr	#/cm2.sr.MeV/n
15.09	24.63	3.	2.3440	0.2457
24.63	35.06	1.	0.7812	0.0749
35.06	52.46	0.	0.0000	0.0000
52.46	70.10	3.	2.4486	0.1388
70.10	94.10	1.	0.8892	0.0370
94.10	114.32	3.	2.9430	0.1455
114.32	147.09	6.	6.7809	0.2069
Sum =		17.	16.1868	

Charge= 12

Energy bin		Evts	#/cm2.sr	#/cm2.sr.MeV/n
15.89	26.03	2.	1.5628	0.1541
26.03	37.13	5.	3.9060	0.3519
37.13	55.66	9.	7.0362	0.3797
55.66	74.42	19.	15.5819	0.8306
74.42	99.99	33.	29.1705	1.1408
99.99	121.54	24.	23.5315	1.0919
121.54	156.52	47.	52.8075	1.5096
Sum =		139.	133.5963	

Charge= 13

Energy bin		Evts	#/cm2.sr	#/cm2.sr.MeV/n
16.41	26.98	0.	0.0000	0.0000
26.98	38.52	2.	1.5627	0.1354
38.52	57.79	3.	2.3469	0.1218
57.79	77.32	5.	4.1537	0.2127

77.32 103.94	1.	0.8795	0.0330
103.94 126.40	6.	5.9546	0.2651
126.40 162.88	16.	18.2414	0.5000
Sum =	33.	33.1387	

Charge= 14

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
17.28 28.45	2.	1.5630	0.1399
28.45 40.66	3.	2.3439	0.1920
40.66 61.05	10.	7.8262	0.3838
61.05 81.75	19.	15.4597	0.7468
81.75 109.95	24.	21.4281	0.7599
109.95 133.78	22.	21.6640	0.9091
133.78 172.52	37.	41.4845	1.0708
Sum =	117.	111.7694	

Charge= 15

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
17.66 29.13	0.	0.0000	0.0000
29.13 41.66	0.	0.0000	0.0000
41.66 62.60	1.	0.7811	0.0373
62.60 83.84	0.	0.0000	0.0000
83.84 112.81	0.	0.0000	0.0000
112.81 137.29	1.	1.0188	0.0416
137.29 177.13	1.	1.2325	0.0309
Sum =	3.	3.0325	

Charge= 16

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
18.37 30.35	0.	0.0000	0.0000
30.35 43.45	1.	0.7815	0.0597
43.45 65.33	0.	0.0000	0.0000
65.33 87.56	4.	3.4158	0.1537
87.56 117.90	3.	2.6703	0.0880
117.90 143.56	3.	2.9163	0.1137
143.56 185.33	4.	4.5857	0.1098
Sum =	15.	14.3695	

Charge= 17

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
18.57 30.79	0.	0.0000	0.0000
30.79 44.17	0.	0.0000	0.0000
44.17 66.50	0.	0.0000	0.0000
66.50 89.17	0.	0.0000	0.0000
89.17 120.11	1.	0.8797	0.0284
120.11 146.30	0.	0.0000	0.0000
146.30 188.96	2.	2.2751	0.0533
Sum =	3.	3.1548	

Charge= 18

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
19.24 31.99	1.	0.7817	0.0613
31.99 45.90	1.	0.7814	0.0562
45.90 69.14	1.	0.7812	0.0336
69.14 92.76	0.	0.0000	0.0000

92.76 125.05	2.	1.7454	0.0541
125.05 152.38	1.	0.9628	0.0352
152.38 196.95	2.	2.1575	0.0484
Sum =	8.	7.2101	

Charge= 19

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
19.62 32.66	0.	0.0000	0.0000
32.66 46.89	0.	0.0000	0.0000
46.89 70.68	1.	0.7812	0.0328
70.68 94.86	0.	0.0000	0.0000
94.86 127.92	0.	0.0000	0.0000
127.92 155.93	0.	0.0000	0.0000
155.93 201.62	1.	1.1608	0.0254
Sum =	2.	1.9420	

Charge= 20

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
20.08 33.50	0.	0.0000	0.0000
33.50 48.16	0.	0.0000	0.0000
48.16 72.66	1.	0.7862	0.0321
72.66 97.59	2.	1.5973	0.0641
97.59 131.68	3.	2.6879	0.0788
131.68 160.57	8.	7.7773	0.2692
160.57 207.75	4.	4.5535	0.0965
Sum =	18.	17.4021	

Charge= 21

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
20.32 33.87	0.	0.0000	0.0000
33.87 48.76	1.	0.7816	0.0525
48.76 73.67	0.	0.0000	0.0000
73.67 98.99	0.	0.0000	0.0000
98.99 133.63	0.	0.0000	0.0000
133.63 162.92	3.	2.9562	0.1009
162.92 210.98	1.	1.2158	0.0253
Sum =	5.	4.9537	

Charge= 22

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
20.74 34.65	0.	0.0000	0.0000
34.65 49.95	1.	0.7815	0.0511
49.95 75.53	2.	1.5625	0.0611
75.53 101.56	1.	0.7918	0.0304
101.56 137.18	7.	6.1785	0.1735
137.18 167.32	4.	3.8326	0.1272
167.32 216.79	5.	5.6404	0.1140
Sum =	20.	18.7872	

Charge= 23

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
20.99 35.21	0.	0.0000	0.0000
35.21 50.85	0.	0.0000	0.0000
50.85 77.03	1.	0.7812	0.0298
77.03 103.66	3.	2.5385	0.0953

103.66 140.11	1.	0.8758	0.0240
140.11 170.97	1.	0.9726	0.0315
170.97 221.64	3.	3.3984	0.0671
Sum =	9.	8.5666	

Charge= 24

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
21.44 36.03	0.	0.0000	0.0000
36.03 52.09	0.	0.0000	0.0000
52.09 79.00	0.	0.0000	0.0000
79.00 106.37	4.	3.2447	0.1186
106.37 143.85	4.	3.5588	0.0950
143.85 175.61	5.	4.8722	0.1534
175.61 227.80	5.	5.6178	0.1076
Sum =	18.	17.2935	

Charge= 25

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
21.75 36.65	1.	0.7820	0.0525
36.65 53.08	1.	0.7816	0.0476
53.08 80.54	1.	0.7880	0.0287
80.54 108.52	2.	1.6399	0.0586
108.52 146.84	5.	4.4817	0.1170
146.84 179.31	2.	1.9229	0.0592
179.31 232.73	8.	8.8286	0.1653
Sum =	20.	19.2249	

Charge= 26

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
22.19 37.49	2.	1.5640	0.1022
37.49 54.31	7.	5.4723	0.3253
54.31 82.50	14.	10.9524	0.3885
82.50 111.20	15.	12.2938	0.4284
111.20 150.56	23.	20.6405	0.5244
150.56 183.94	27.	26.3390	0.7891
183.94 238.88	25.	28.1062	0.5116
Sum =	113.	105.3682	

Charge= 27

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
22.49 38.10	0.	0.0000	0.0000
38.10 55.29	0.	0.0000	0.0000
55.29 84.09	0.	0.0000	0.0000
84.09 113.44	0.	0.0000	0.0000
113.44 153.69	1.	0.8741	0.0217
153.69 187.75	2.	2.0683	0.0607
187.75 244.10	0.	0.0000	0.0000
Sum =	3.	2.9424	

Charge= 28

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
23.19 39.33	0.	0.0000	0.0000
39.33 57.10	0.	0.0000	0.0000
57.10 86.91	1.	0.7886	0.0265
86.91 117.32	0.	0.0000	0.0000

117.32 159.05	1.	0.8769	0.0210
159.05 194.41	1.	0.9830	0.0278
194.41 252.93	2.	2.2397	0.0383
Sum =	5.	4.8882	

Charge= 29

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
22.85 38.92	0.	0.0000	0.0000
38.92 56.63	0.	0.0000	0.0000
56.63 86.34	0.	0.0000	0.0000
86.34 116.63	0.	0.0000	0.0000
116.63 158.20	0.	0.0000	0.0000
158.20 193.39	0.	0.0000	0.0000
193.39 251.65	0.	0.0000	0.0000
Sum =	0.	0.0000	

Charge= 30

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
23.26 39.69	0.	0.0000	0.0000
39.69 57.82	0.	0.0000	0.0000
57.82 88.21	0.	0.0000	0.0000
88.21 119.22	0.	0.0000	0.0000
119.22 161.81	0.	0.0000	0.0000
161.81 197.89	0.	0.0000	0.0000
197.89 257.64	0.	0.0000	0.0000
Sum =	0.	0.0000	

Table 3.

Flux ratios values for several selected pairs of nuclei (Voyager-1, 1986-87). Table is generated with the program CORRATIO2.

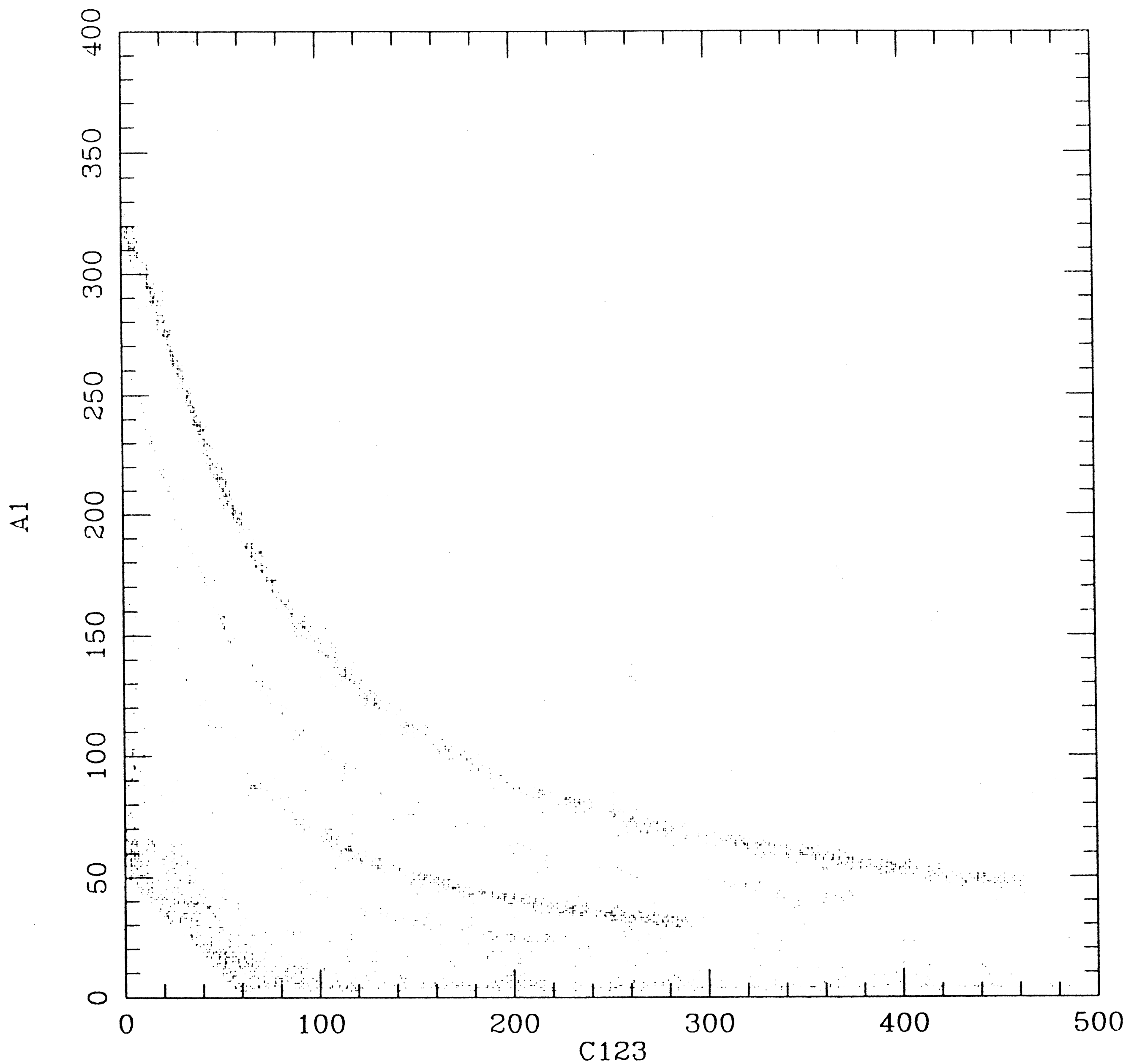
```
Elt      FluxBS    #evt    Emin    Emax      Anomal.    Error    Index   error
Be        21.75     27.    40.16   104.51      0.00     0.00
C        592.71    737.    50.04   130.95      0.00     0.00     0.99   0.11
Assump.   Raw rat.  Rgecor          Ratio    Error
nominal     0.0367  1.5677         0.0575  0.0113
gam min     0.0367  1.5302         0.0562  0.0110
gam max     0.0367  1.6062         0.0589  0.0115

Be/C  =  0.0575 +- 0.0113 +- 0.0014      =  0.0575 +- 0.0127

Energy of measurement:  77.04  + 27.47 - 36.88 MeV/n
```

```
Elt      FluxBS    #evt    Emin    Emax      Anomal.    Error    Index   error
B        108.62    137.    43.67   113.90      0.00     0.00
C        592.71    737.    50.04   130.95      0.00     0.00     0.99   0.11
Assump.   Raw rat.  Rgecor          Ratio    Error
nominal     0.1833  1.3206         0.2420  0.0225
gam min     0.1833  1.3009         0.2384  0.0222
gam max     0.1833  1.3405         0.2457  0.0229

B /C  =  0.2420 +- 0.0225 +- 0.0037      =  0.2420 +- 0.0262

Energy of measurement:  83.93  + 29.97 - 40.26 MeV/n
```

```
Elt      FluxBS    #evt    Emin    Emax      Anomal.    Error    Index   error
Na        28.67     36.    68.56   181.63      0.00     0.00
Mg       186.86    241.    72.78   193.43      0.00     0.00     0.95   0.22
Assump.   Raw rat.  Rgecor          Ratio    Error
nominal     0.1534  1.1322         0.1737  0.0310
gam min     0.1534  1.1170         0.1714  0.0306
gam max     0.1534  1.1476         0.1761  0.0315

Na/Mg =  0.1737 +- 0.0310 +- 0.0024      =  0.1737 +- 0.0334

Energy of measurement: 133.25  + 48.38 - 64.69 MeV/n
```

```
Elt      FluxBS    #evt    Emin    Emax      Anomal.    Error    Index   error
Al        32.91     41.    75.61   201.42      0.00     0.00
Si       156.87    202.    79.93   213.53      0.00     0.00     0.43   0.20
Assump.   Raw rat.  Rgecor          Ratio    Error
nominal     0.2098  1.0886         0.2284  0.0391
gam min     0.2098  1.0761         0.2258  0.0387
gam max     0.2098  1.1013         0.2310  0.0396

Al/Si =  0.2284 +- 0.0391 +- 0.0027      =  0.2284 +- 0.0418

Energy of measurement: 142.75  + 58.67 - 67.14 MeV/n
```

3-FEB-89 15:09:43

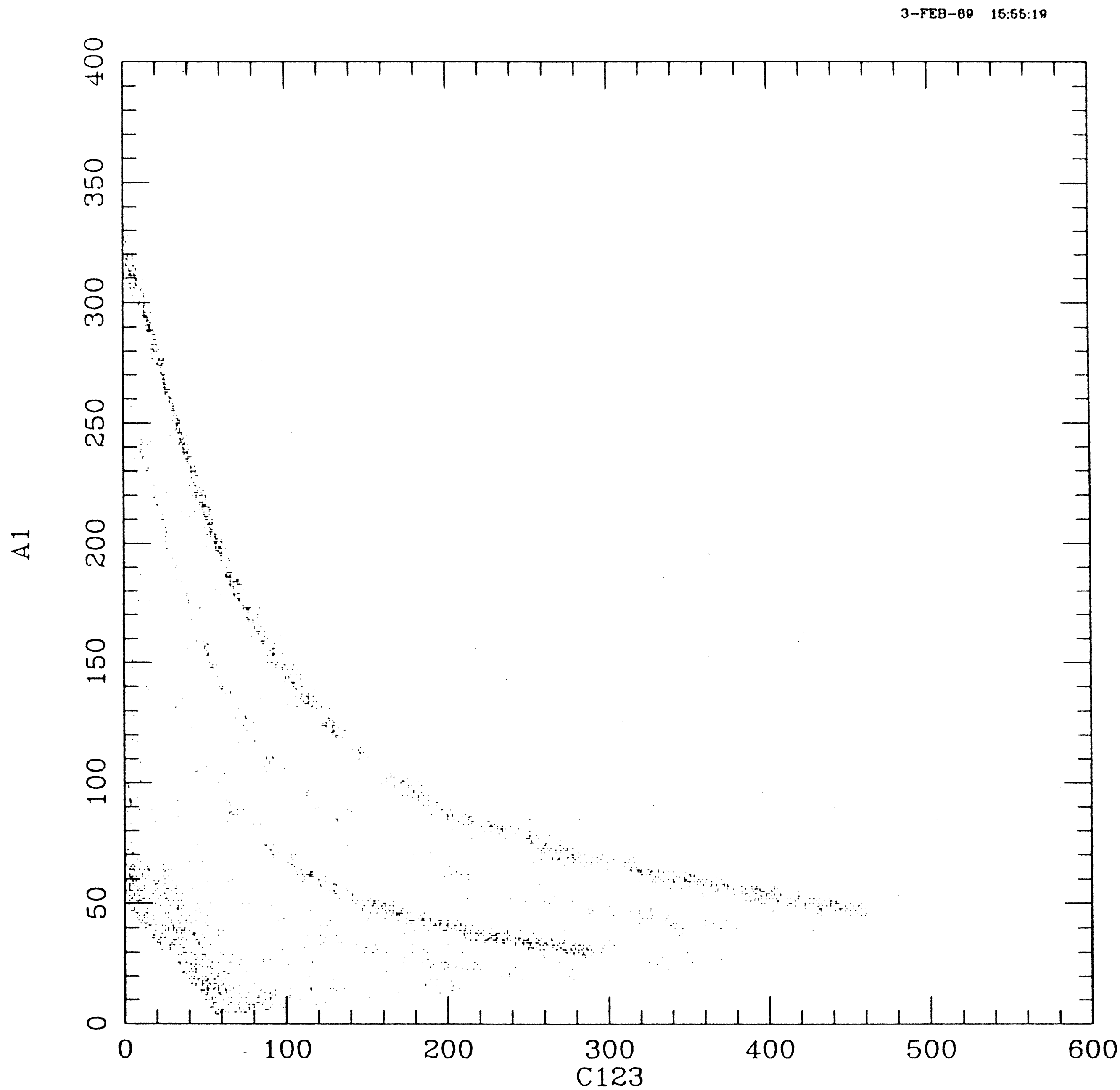


data file: s1v18687ast.dat

evts read and selected: 4681 4681

No selection on charge consistency

Fig.1 The A-stopping events (Voyager-1, 1986-87) selected by the program COPY_FILE. Events corresponding to Helium and Hydrogen elements are removed. The plot is produced with the program MATDRAW.

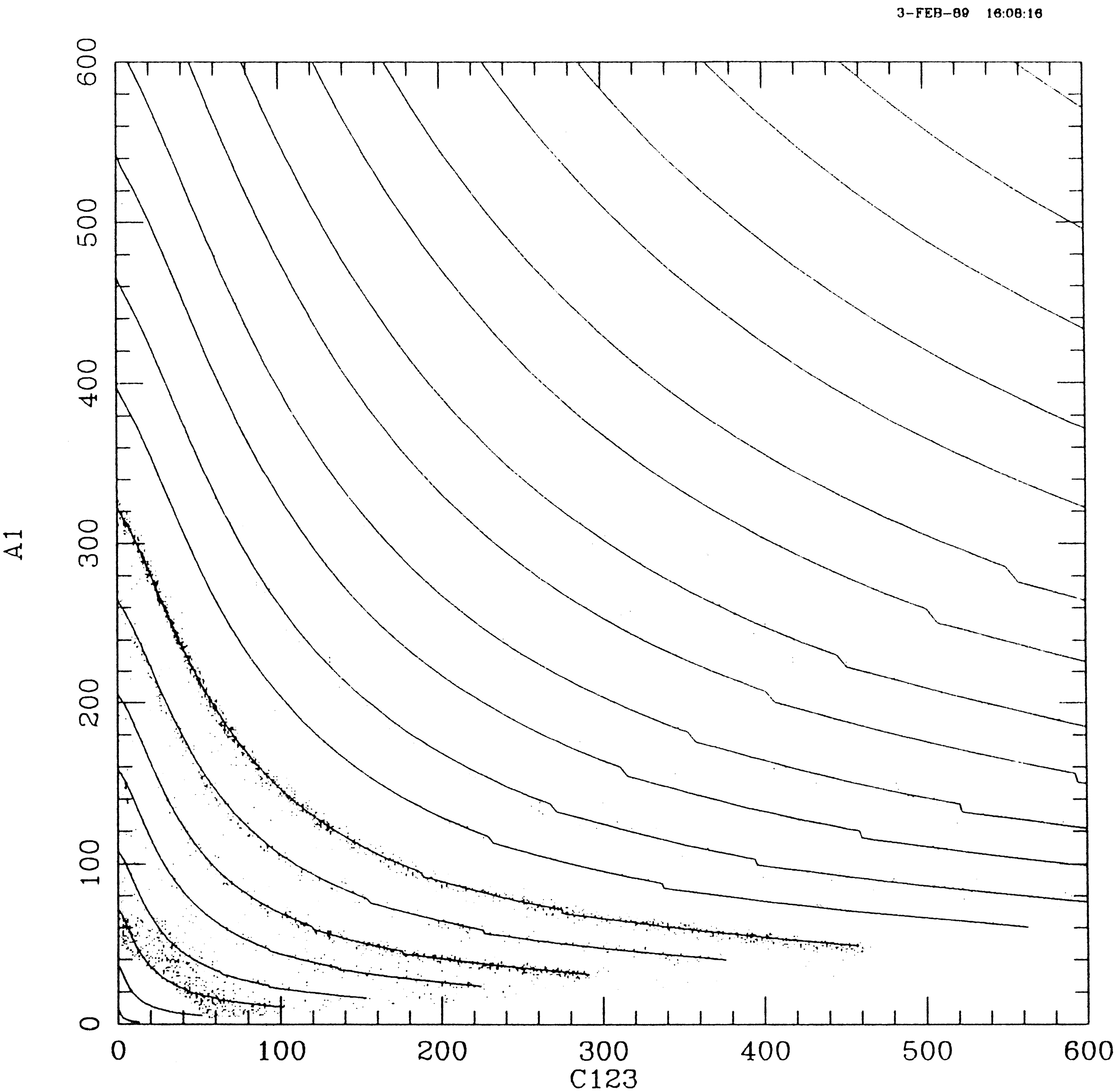


data file: s2v18687ast.dat

evts read and selected: 4079 4079

No selection on charge consistency

Fig.2 Further selection of A-stopping events (Voyager-1, 1986-87) performed by the program CUT_SIGNAL. Noise events with very low energy in detector layer A1 are removed. This plot is produced with the program MATDRAW.



data file: s2v18687ast.dat

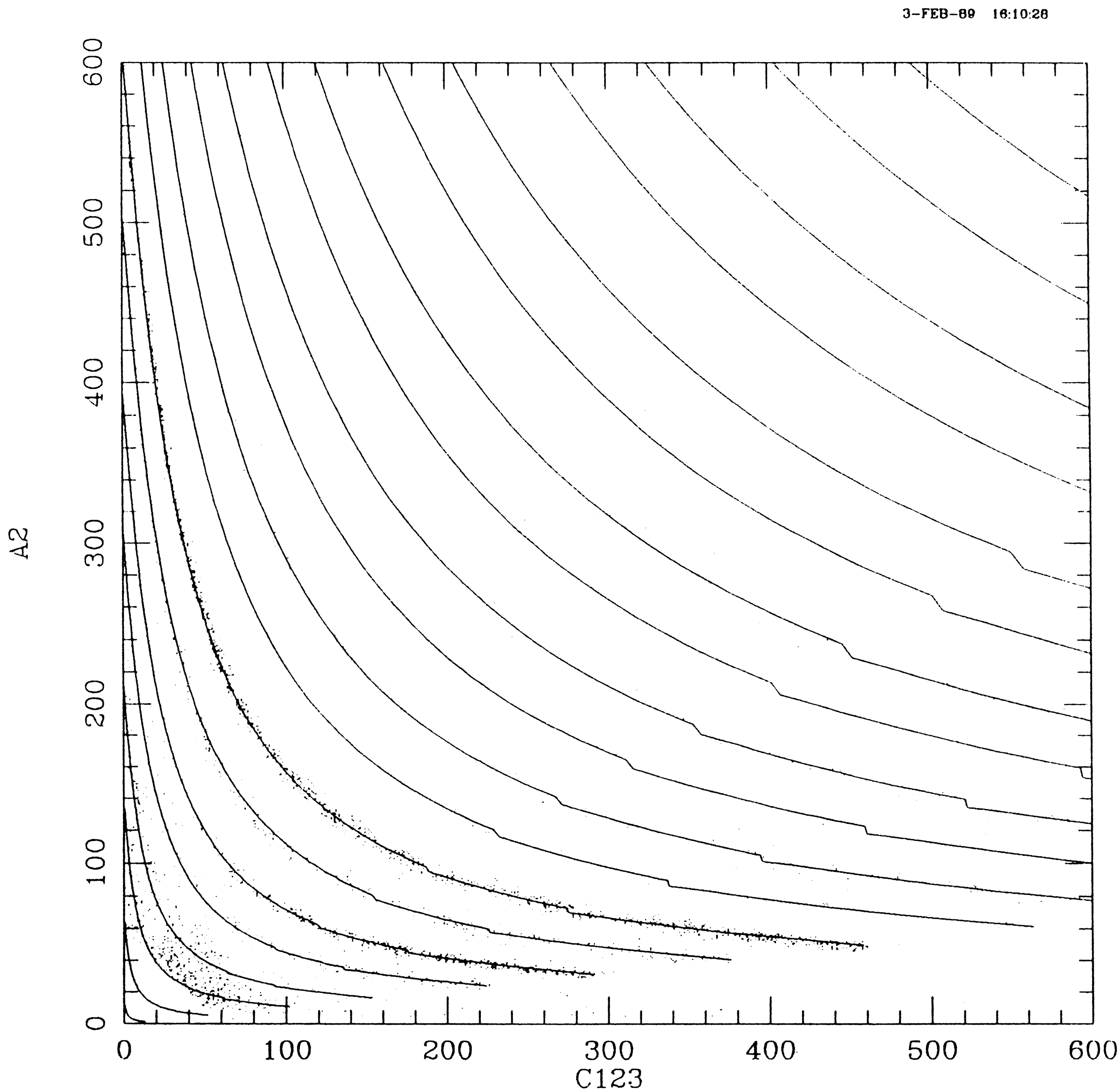
evts read and selected: 4079 4079

No selection on charge consistency

simulation file: repv1dl1.sim

Offset D1, D2, C:	0.00	0.00	0.00
FSMeV D1, D2, C:	936.	915.	17400.

Fig.3 Fit of simulation tracks to A-stopping experimental events (Voyager-1, 1986-87). The events are represented by energies deposited in A1 and C123 detector layers. Plot and fit performed with program MATDRAW.



data file: s2v18687ast.dat

evts read and selected: 4079 4079

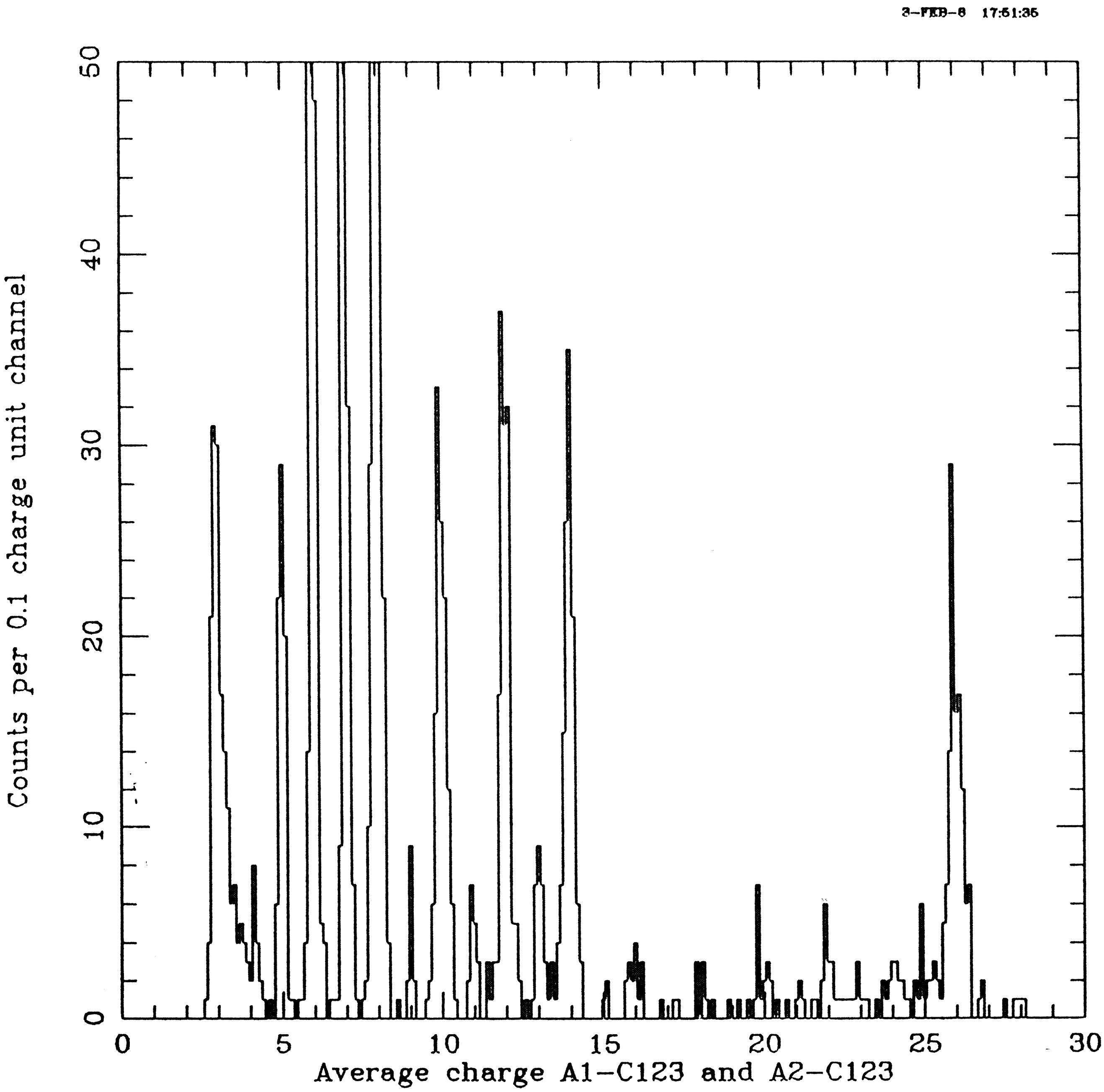
No selection on charge consistency

simulation file: repv1dl1.sim

Offset D1, D2, C: 0.00 0.00 0.00

FSMeV D1, D2, C: 935. 915. 17400.

Fig.4 The same as in Fig.3 for the energies deposited in A2 and C123 detector layers.



data file: s3v18687ast.dat

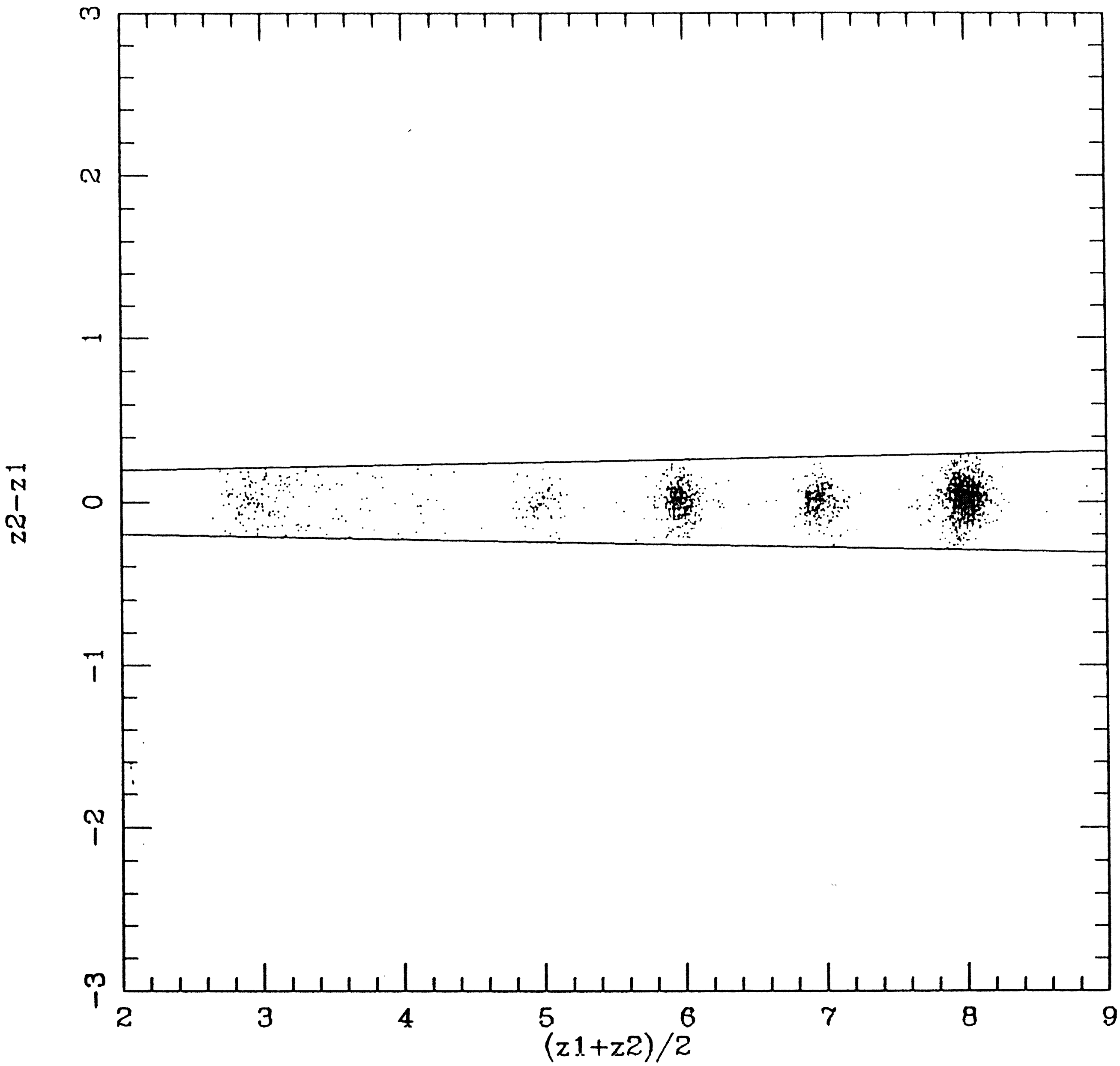
evts read: 4079

3198evts selected with |Z2-Z1| < 3.00 sigma

sigma = 0.0550 + 0.0055*zav

Fig.5 The histogram of average charge for A-stopping events (Voyager-1,. 1986-87). The histogram was used to determine charge intervals. Plot is produced with program PLRESZ.

6-FEB-8 09:38:56



data file: s3v18687ast.dat

evts read: 4079

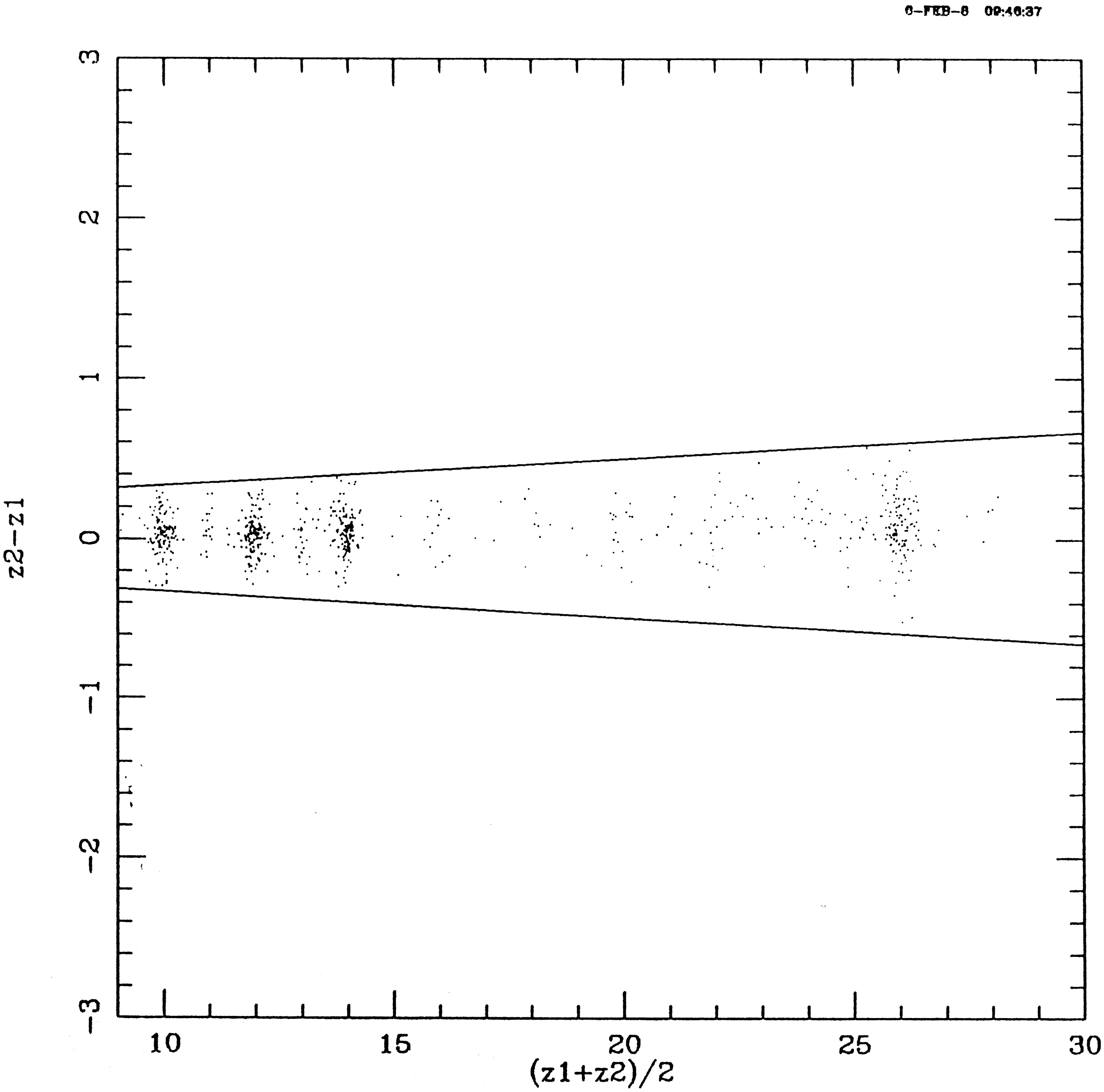
3198evts selected with |Z2-Z1| < 3.00 sigma

sigma = 0.0550 + 0.0055*zav

Lines drawn: |Z2-Z1| = 3.00 sigma

sigma = 0.0550 + 0.0055*z

Fig.6 Charge spread versus average charge for A-stopping events (Voyager-1, 1986-87). Two solid lines mark three standard deviations in charge spread. Plot is produced with the program PLRESZ.



data file: s3v18687ast.dat

evts read: 4079

3198evts selected with |Z2−Z1| < 3.00 sigma

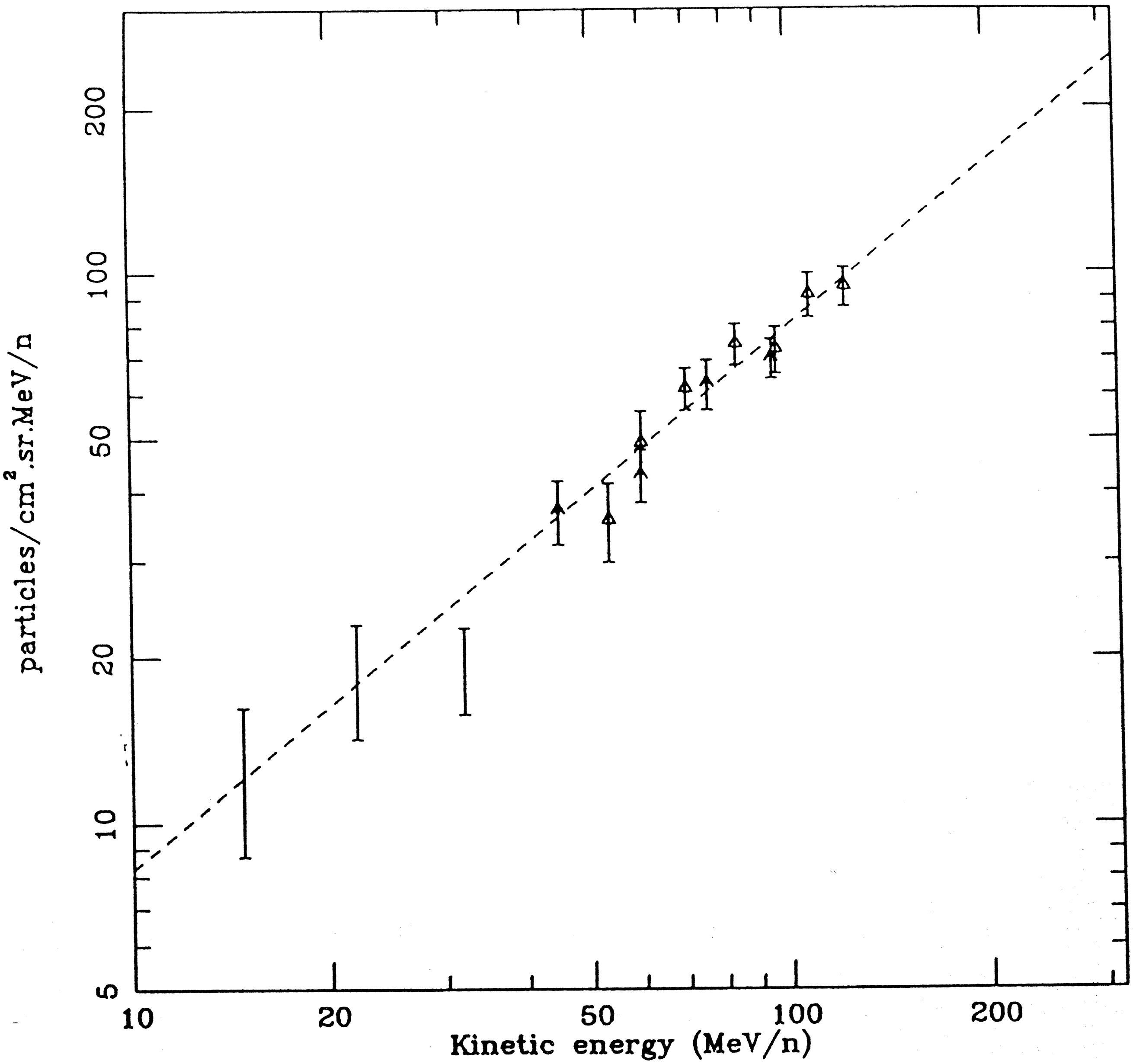
sigma = 0.0550 + 0.0055*zav

Lines drawn: |Z2−Z1| = 3.00 sigma

sigma = 0.0550 + 0.0055*z

Fig.7 The same as in Fig.6 for larger Z values.

2-FEB-8 13:44:17



C : ^ AS fluxre.dat Δ BS fbs2v18687.dat

Fitted Galactic spectrum: dJ/dE= 0.854E−01*E $^{0.965+- \quad 0.108}$

All fluxes times 10.0 TimeAS/TimeBS = 1.000

Fig.8 Flux versus energy (log-log scale) for A-stopping and B-stopping events (Voyager-1, 1986-87). Only some of the experimental values of flux which are within energy interval of interest are used to calculate slope of a galactic component of flux.

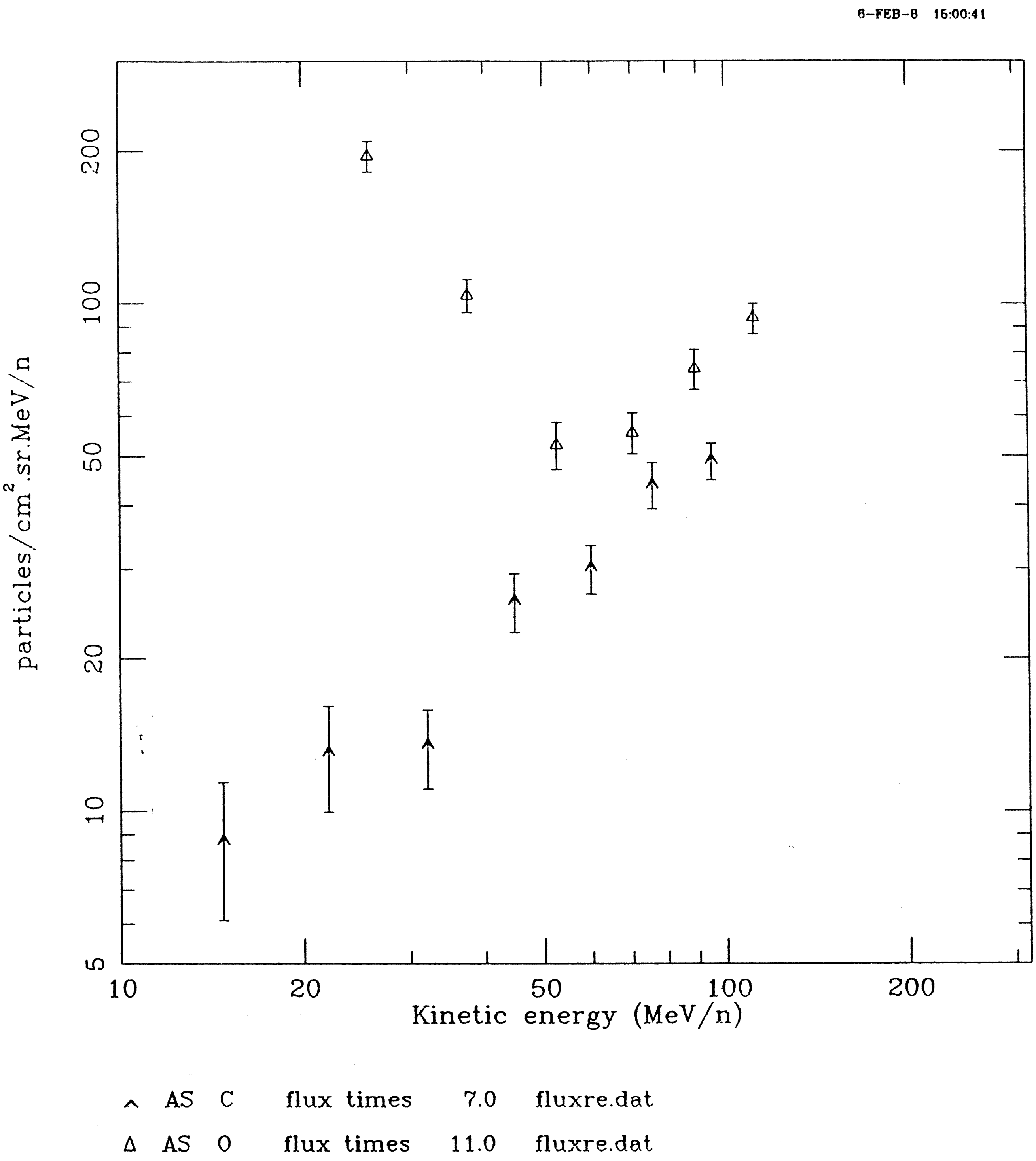


Fig.9 Flux versus energy (log-log scale) for two elements, C and O. The values of flux presented in figure are obtained from the analysis of only A-stopping events (Voyager-1, 1986-87).